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(54) **RADIATION GENERATING APPARATUS AND RADIATION IMAGING SYSTEM**

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A61B 6/06 (2006.01)
A61B 6/08 (2006.01)

(52) **U.S. Cl.**
CPC ... ***G21K 1/04*** (2013.01); ***A61B 6/06*** (2013.01); ***A61B 6/08*** (2013.01)

(58) **Field of Classification Search**
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USPC 378/62, 63, 145, 161, 205, 206, 147
See application file for complete search history.

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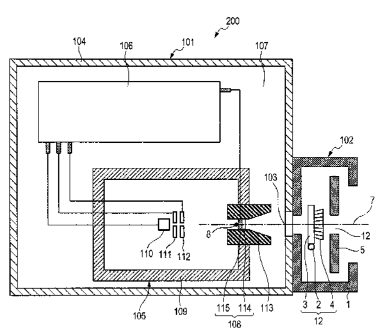
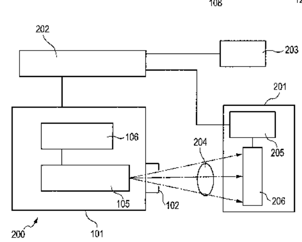
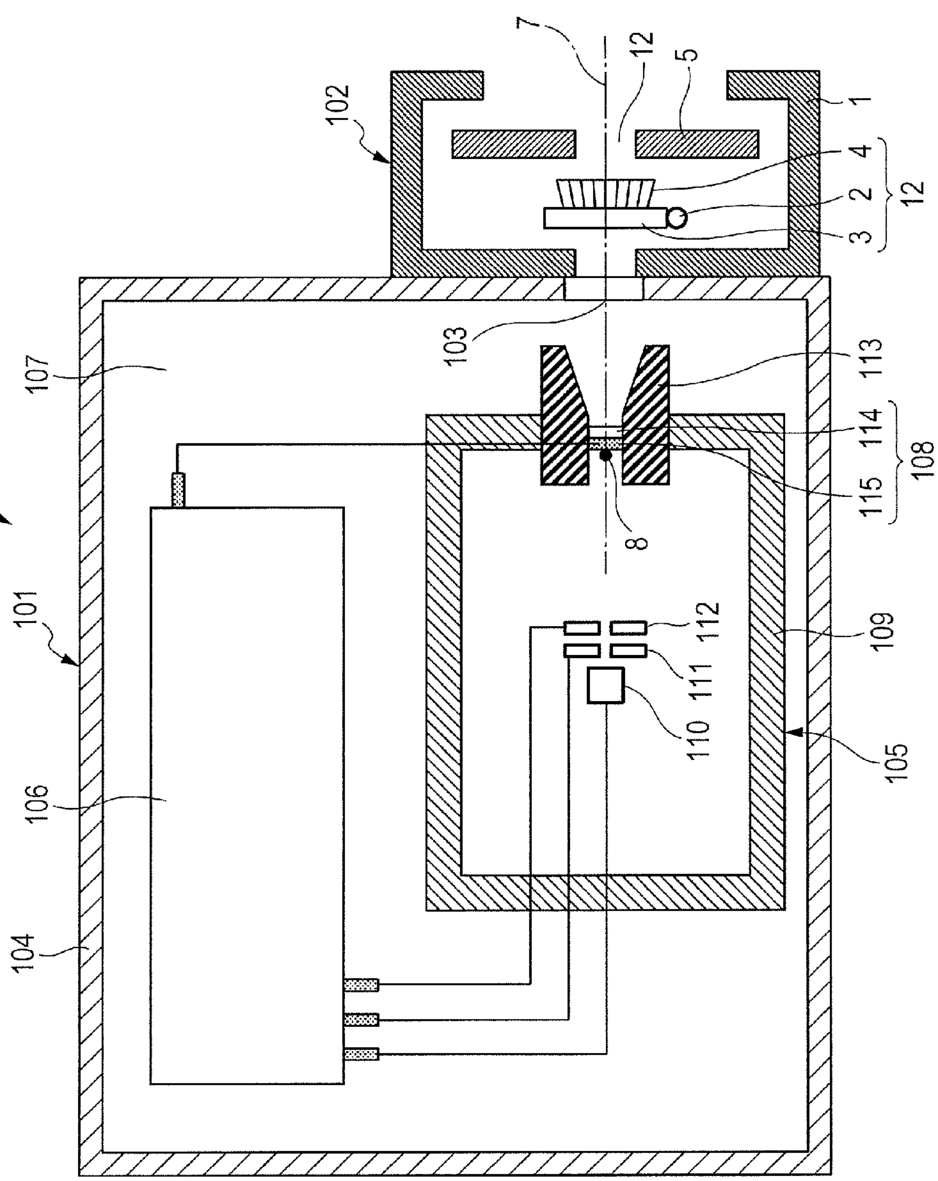
(57) **ABSTRACT**

Provided is a radiation generating apparatus, including: a radiation generating unit for emitting radiation; and a movable diaphragm unit including a light projecting/sighting system for making a simulation display of a radiation field with visible light. The light projecting/sighting system includes: a light source of the visible light; a light guiding plate that is provided across a radiation axis, and causes the visible light from the light source to exit from a front surface of the light guiding plate; and a louver that gives directivity to the visible light exiting from the front surface of the light guiding plate.

16 Claims, 3 Drawing Sheets







200
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
1
2
3
4
5
7
8
12

FIG. 1

FIG. 2A

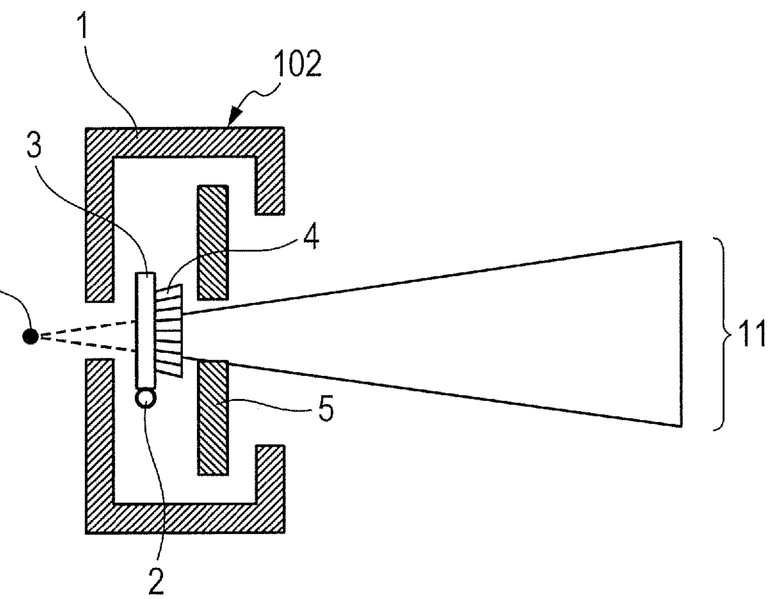


FIG. 2B

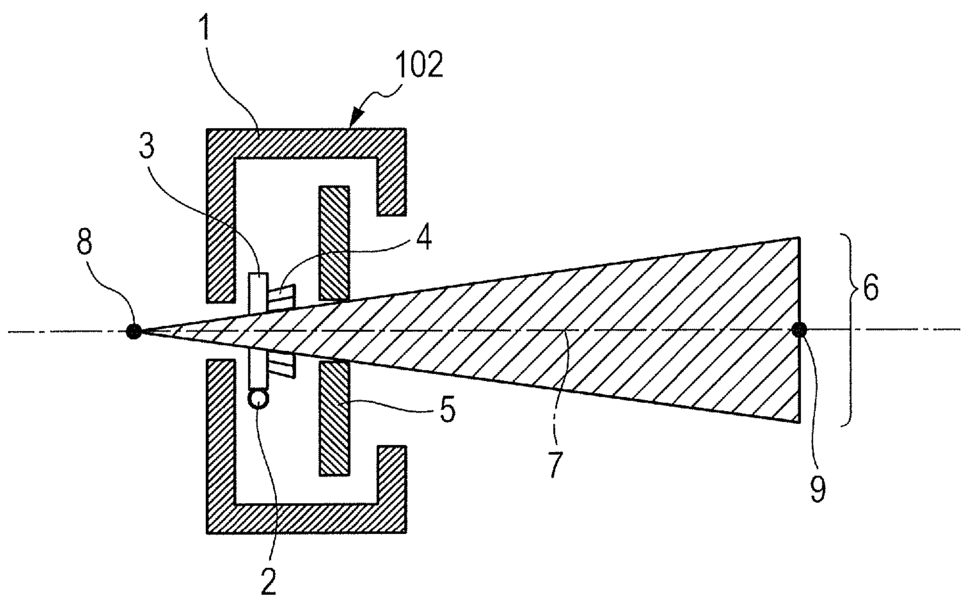


FIG. 3A

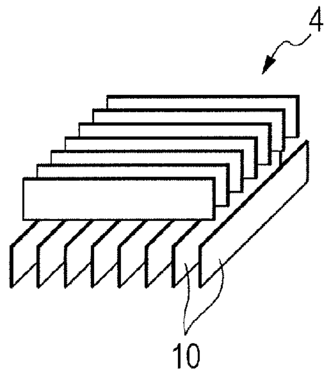


FIG. 3B

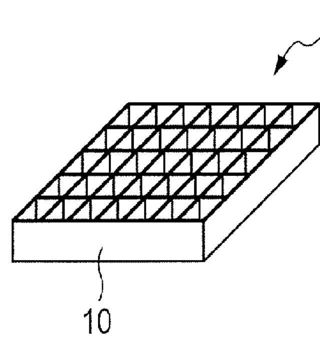


FIG. 3C

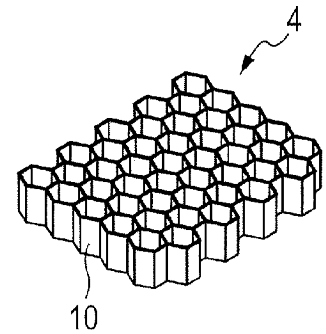
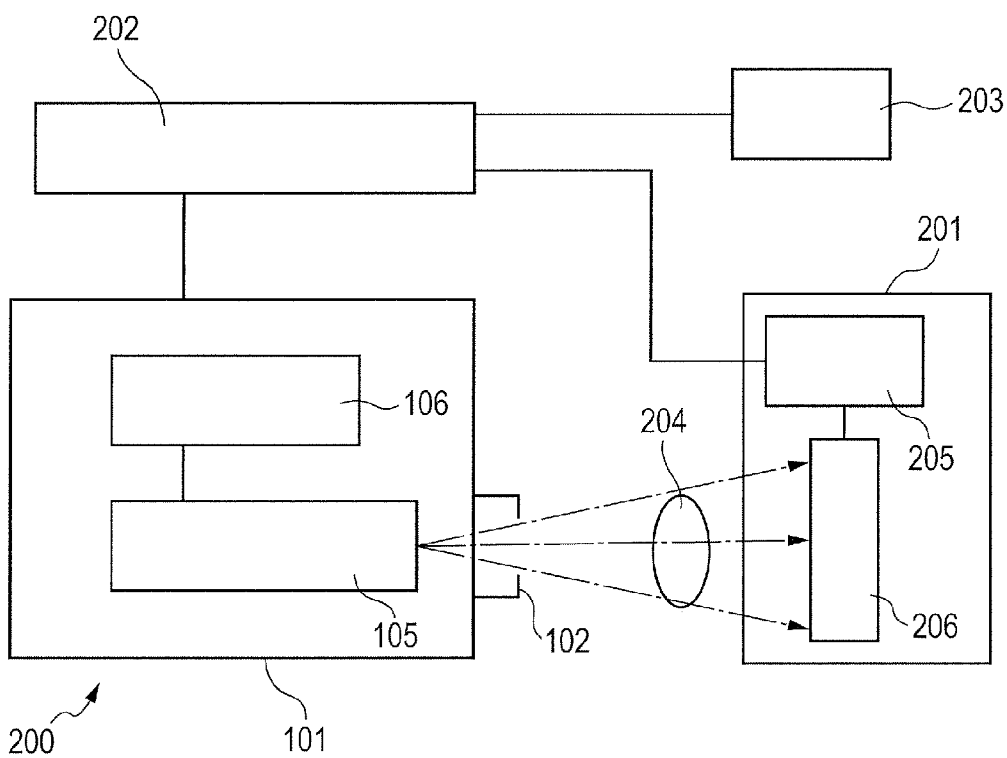


FIG. 4



RADIATION GENERATING APPARATUS AND RADIATION IMAGING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a radiation generating apparatus including a movable diaphragm unit including a light projecting and sighting system (hereinafter, referred to as "light projecting/sighting system") for making a simulation display of a radiation field as a visible light field, and to a radiation imaging system using the radiation generating apparatus.

2. Description of the Related Art

A typical radiation generating apparatus includes a radiation generating unit including a radiation tube and a movable diaphragm unit provided on a front surface of a radiation transmission window of the radiation generating unit.

As disclosed in Japanese Patent Application Laid-Open No. H07-148159, the movable diaphragm unit includes a light projecting/sighting system including a reflecting plate that transmits radiation and reflects visible light and a light source of visible light. The movable diaphragm unit further includes limiting leaves for defining a radiation field and a visible light field formed correspondingly thereto. The light source is provided off an irradiation path of radiation which irradiates a necessary radiation field so as not to interfere with the radiation when emitted. The reflecting plate is provided so as to be slanted with respect to a central axis of the radiation in order to reflect visible light from the light source provided in this way to form a visible light field for making a simulation display of the radiation field. Further, the light source and the reflecting plate are, together with the limiting leaves, provided in an envelope which blocks radiation. The envelope is formed of a material which can attenuate radiation that impinges on the reflecting plate and the limiting leaves to be dispersed.

However, in the conventional movable diaphragm unit, the reflecting plate of the light projecting/sighting system is provided so as to be slanted, and thus, the envelope covering the reflecting plate becomes large, which is a factor in hindering size reduction of the radiation generating apparatus and a radiation imaging system using the radiation generating apparatus. Further, the material for forming the envelope which can attenuate radiation is a heavy mass material, and thus, there is a problem of increased weight.

On the other hand, the conventional movable diaphragm unit has an advantage in that, when the radiation tube provided in the radiation generating apparatus is a reflection type radiation tube, the reflecting plate provided so as to be slanted can alleviate, by the heel effect, the radiation quantity and radiation quality distribution. However, when a radiation tube of a transmission type which does not cause the heel effect is used, the reflecting plate provided so as to be slanted generates the radiation quantity and radiation quality distribution.

SUMMARY OF THE INVENTION

It is an object of the present invention to reduce the size and the weight of a movable diaphragm unit including a light projecting/sighting system and to inhibit the radiation quantity and radiation quality distribution when a radiation tube of a transmission type is used.

In order to solve the above mentioned problem, according to an aspect of the present invention, there is provided a radiation generating apparatus, including; a radiation generating unit for emitting radiation; and a movable diaphragm unit including a light projecting/sighting system for making a simulation display of a radiation field with visible light, in which the light projecting/sighting system includes; a light source of the visible light, the light source being provided outside a path of the radiation that irradiates the radiation field, a light guiding plate provided across a radiation axis so as to cover the path of the radiation that irradiates the radiation field, the light guiding plate being configured to transmit the radiation and cause the visible light from the light source to exit from a front surface of the light guiding plate; and a louver configured to transmit the radiation and partition a region from which the visible light exits on the front surface of the light guiding plate.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating a radiation generating apparatus according to an embodiment of the present invention.

FIGS. **2**A and **2**B are schematic views of a movable diaphragm unit according to the present invention.

FIGS. **3**A, **3**B and **3**C are schematic views of louvers according to the present invention.

FIG. **4** is a block diagram illustrating a radiation imaging system according to an embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENT

In the following, an exemplary embodiment of the present invention is described in detail with reference to the attached drawings. Throughout the figures referred to in the following, like reference symbols are used to designate like components.

FIG. **1** is a schematic view illustrating a structure of a radiation generating apparatus according to the present invention.

A radiation generating apparatus **200** includes a radiation generating unit **101** and a movable diaphragm unit **102**.

The radiation generating unit **101** includes a housing **104** having a radiation transmission window **103**, a radiation tube **105** that is housed in the housing **104** and is a supply source of radiation, and a drive circuit **106** for driving the radiation tube **105**. The space remaining in the housing **104** is filled with an insulating liquid **107** that has the function of maintaining electrical insulation inside the housing **104** and serves as a cooling medium for the radiation tube **105**.

It is desired that the housing **104** be strong enough as a container and be excellent in heat dissipation. Exemplary suitable materials used for forming the housing **104** include a metal material such as brass, iron, or stainless steel.

The radiation tube **105** is a transmission type radiation tube, and includes a vacuum container **109** having a target **108** mounted to a window portion thereof, and a cathode **110**, a grid electrode **111**, and a lens electrode **112** provided in the vacuum container **109**. Further, a shielding member **113** is provided so as to surround the target **108**, which blocks unnecessary radiation.

The target **108** is formed by providing a target layer **115** for generating radiation through electron irradiation on a support substrate **114** which satisfactorily transmits radiation, and is mounted under a state in which a side thereof which has the target layer **115** provided thereon is on the inner side. As the target layer **115**, for example, tungsten, tantalum, or molybdenum is used. The target layer **115** is electrically connected to the drive circuit **106** and forms part of an anode.

The barrel of the vacuum container **109** is formed of an insulating tube of an insulating material such as glass or ceramic so as to maintain a vacuum of the inside thereof and to electrically insulate between the cathode **110** and the anode including the target layer **115**. The pressure inside the vacuum container **109** is reduced for the purpose of causing the cathode **110** to function as an electron source. It is preferred that the vacuum thereof be about 10^{-4} Pa to 10^{-8} Pa.

The cathode **110** is an electron source and is provided so as to be opposed to the target layer **115** of the target **108**. As the cathode **110**, for example, a hot cathode such as a tungsten filament or an impregnated cathode, or a cold cathode such as a carbon nanotube can be used. The cathode **110**, the grid electrode **111**, and the lens electrode **112** are electrically connected to the drive circuit **106**, and predetermined voltages are applied thereto. A voltage Va applied between the cathode **110** and target layer **115** depends on the use of the radiation, but generally is about 10 kV to 150 kV.

Electrons that are derived from the cathode **110** are converged by the lens electrode **112** and enter the target layer **115** of the target **108**, to thereby generate radiation. The generated radiation passes through the support substrate **114** of the target **108**, and further, through the radiation transmission window **103**, the radiation is emitted to the outside of the radiation generating unit **101**.

The movable diaphragm unit **102** is provided outside the radiation transmission window **103** provided in the housing **104** of the radiation generating unit **101**. The movable diaphragm unit **102** includes an envelope **1** that surrounds the radiation transmission window **103**, and a light projecting/sighting system **12** and limiting leaves **5** that are provided in the envelope **1**. The light projecting/sighting system **12** includes a light source **2** of visible light, a light guiding plate **3**, and a louver **4**.

The envelope **1** has the effect of blocking radiation and, for example, blocks radiation reflected by the light guiding plate **3** and the limiting leaves **5**, to thereby prevent surplus exposure to radiation. The envelope **1** is formed of a material which has the effect of blocking radiation, and a metal such as lead, tungsten, or tantalum, an alloy thereof, or the like may be used. Alternatively, by forming the envelope **1** using a metal such as aluminum or a synthetic resin which is less effective in blocking radiation, and providing thereto a metal sheet which has the enhanced effect of blocking radiation, the weight can be reduced.

FIGS. **2**A and **2**B are schematic views of the movable diaphragm unit according to the present invention. FIG. **2**A illustrates the movable diaphragm unit when visible light is emitted, and FIG. **2**B illustrates the movable diaphragm unit when radiation is emitted. The light source is provided outside the path of radiation which irradiates a radiation field **6** (a diagonally shaded portion in FIG. **2**B). It is enough that the light source **2** emits visible light and irradiates a range corresponding to the radiation field **6** with visible light of satisfactory brightness, and as the light source **2**, for example, an incandescent lamp, a halogen lamp, a xenon lamp, or a light-emitting diode (LED) can be used. Among those, an LED is preferred because of the easiness of size reduction thereof.

The light guiding plate **3** causes visible light that enters from the light source **2** to exit from a front surface thereof. The rear surface of the light guiding plate **3** is a ground glass-like surface having minute irregularities, and the light guiding plate **3** can be formed of a transparent synthetic resin plate having a reflecting material provided on the rear surface and three side surfaces thereof. An LED as the light source **2** is located so as to be opposed to the remaining one side surface on which the reflecting material is not provided. By causing visible light to enter from the one side surface on which the reflecting material is not provided, surface emission from the front surface can be performed. The light guiding plate **3** is formed of a light element material having high radiation transmittance, and as the light guiding plate **3**, for example, a synthetic resin such as an acrylic resin can be used.

The light guiding plate **3** is provided in the envelope **1** so as to cross the path of radiation which irradiates the radiation field **6**. The light guiding plate **3** is provided across a radiation axis **7** so as to cover the path of the radiation. The visible light exiting surface of the light guiding plate **3** can be in a direction orthogonal to a radiation axis **7**, in order to reduce the whole volume of the movable diaphragm unit **102**. The radiation axis **7** as used herein is a straight line that connects a radiation focus **8** and a center **9** of the radiation field **6** when the limiting leaves **5** are opened at the maximum. The radiation focus **8** as used herein is the center of a location at which radiation is generated, and is the center of an electron beam irradiation region of the target layer **115**. The center **9** of the radiation field **6** as used herein is a location corresponding to, when a plate material having the same shape and size as those of the radiation field **6** and having a uniform thickness is assumed, the center of the gravity of the plate material.

FIGS. **3**A to **3**C are perspective views of louvers according to the present invention. The louver **4** is provided on the front surface of the light guiding plate **3**, for giving directionality to visible light exiting from the front surface of the light guiding plate **3**. The louver **4** is an aggregation of partition walls **10**, and partitions the region from which visible light exits and controls the direction of exiting light. The louver **4** illustrated in FIG. **3**A has the shape of intersecting slits in two stages in which the multiple parallel plate-like partition walls **10** are arranged in directions perpendicularly intersecting each other, respectively. The louver **4** gives directionality to visible light exiting from the front surface of the light guiding plate **3** by partitioning, with the partition walls **102** in the two stages, the region from which the visible light exits into cells in a grid, and controlling the directions of visible light exiting from the respective cells in the grid. The louver **4** illustrated in FIG. **3**B has the shape of a grid formed by crossing multiple plate-like partition walls **10** perpendicularly in one plane. The louver has the shape of a grid formed by the partition walls **10** in one stage, and gives directionality to visible light exiting from the front surface of the light guiding plate **3** by partitioning the region from which the visible light exits into cells in the grid, and controlling the directions of visible light exiting from the respective cells in the grid. The louver **4** illustrated in FIG. **3**C has the shape of a honeycomb that is an aggregation of multiple hexagonal partition walls. The louver **4** gives directionality to visible light by causing the visible light to exit from the respective hexagonal regions and controlling the directions thereof. The louvers **4** illustrated in FIG. **3**B and FIG. **3**C have an advantage over the louver **4** illustrated in FIG. **3**A in the easiness of size reduction thereof.

The louver **4** (partition walls **10**) is formed of a light-blocking material that can transmit radiation and control the direction of exiting visible light. It is preferred that the louver **4** be formed of a light element having high radiation transmittance which blocks light. The louver **4** can be formed of, for example, a graphite foil, or paper or a synthetic resin film colored with a black coating such as carbon black so as to block light.

It is preferred that the aspect ratio, that is, the ratio between a width (or diameter) w and a height h (h/w) of a light exiting cell in the above-mentioned louver **4** in the shape of intersecting slits, in the shape of a grid, or in the shape of a honeycomb be 50 or more in order to give satisfactory directionality.

Further, it is preferred that the aspect ratio be 500 or less from the viewpoint of reducing space necessary for installing the apparatus.

It is preferred that the partition walls **10** of the louver **4** be slanted on the outer peripheral side under a state in which the amount of the slant is gradually increased from the radiation axis **7** side to the outer peripheral side. The slant allows directionality to be given to visible light so that the visible light expands similarly to the path of gradually expanding radiation for irradiation. It is preferred that the partition walls **10** be slanted so that extensions of the slanted surfaces of the partition walls **10** to the radiation generating unit **101** side converge to the radiation focus **8**. The slant enables light from an imaginary light source located at the radiation focus **8** to form a visible light field **11** as illustrated in FIG. **2**A, and the visible light field **11** having a size and a shape substantially the same as those of the radiation field **6** illustrated in FIG. **2**B can be formed.

The limiting leaves **5** are formed of a material that blocks radiation and, as illustrated in FIG. **1**, have an opening **12** for allowing passage of radiation formed at the center thereof. Radiation emitted from the radiation generating unit **101** passes through the opening **12** to be emitted to the outside, to thereby form the radiation field **6**. By adjusting the size of the opening **12**, the size of the radiation field **6** can be adjusted.

As the limiting leaves **5**, for example, two plate materials each having a notch or a hole, which are overlapped so that the notches or the holes are coincident with each other and so as to be slidingly movable with respect to each other, can be used. In this case, the opening **12** is formed as a portion at which the notches or the holes are coincident with each other. By sliding the two plate materials with respect to each other, the size of the opening **12** can be adjusted. Further, there can be used multiple plate materials overlapping with one another so as to be slidingly movable in a manner that the locations thereof are shifted from one another so as to form the opening **12** by surrounding the opening with the plate materials, or a structure like a shutter of a camera.

In using the radiation generating apparatus **200**, ordinarily, prior to emission of radiation, the radiation field **6** is recognized by the naked eye through a simulation display of the visible light field **11**. Visible light which enters the light guiding plate **3** from the light source **2** exits from the front surface of the light guiding plate **3**, is given directionality by the louver **4**, and passes through the opening **12** in the limiting leaves **5** to form the visible light field **11**. In this state, the size of the opening **12** in the limiting leaves **5** is adjusted to be suitable for the size of the appropriate radiation field **6**. After the size of the radiation field **6** is determined, the light source **2** is turned off, and the radiation generating unit **101** is driven.

Radiation generated from the radiation tube **105** passes through the radiation transmission window **103** to be emitted to the movable diaphragm unit **102**. The radiation emitted to the movable diaphragm unit **102** passes through the light guiding plate **3**, and part thereof further passes through the louver **4** and through the opening **12** in the limiting leaves **5**, to thereby irradiate the predetermined radiation field **6** (see FIG. **2**B).

The radiation tube **105** used in this embodiment is a transmission type radiation tube, but, according to the present invention, a radiation tube of a reflection type can also be used. However, the light projecting/sighting system **12** according to the present invention does not use a conventional reflecting plate provided so as to be slanted, and thus, the cancelling action of the heel effect in a radiation tube of a reflection type is less liable to be obtained.

By slidingly moving at least the light guiding plate **3** and the louver **4** when radiation is emitted, the light guiding plate **3** and the louver **4** can be retracted outside the path of radiation which irradiates the radiation field **6**. Further, the entire light projecting/sighting system (the light source **2**, the light guiding plate **3**, and the louver **4**) may be moved. When such a retracting mechanism is provided, the light guiding plate **3** and the louver **4** can be formed of a material which blocks radiation.

Next, a radiation imaging system according to an embodiment of the present invention is described with reference to FIG. **4**.

A system controlling apparatus **202** controls the radiation generating apparatus **200** and a radiation detecting apparatus **201** in a coordinated manner. The drive circuit **106** outputs various kinds of control signals to the radiation tube **105** under the control of the system controlling apparatus **202**. Such a control signal controls the emission state of radiation emitted from the radiation generating apparatus **200**. Radiation emitted from the radiation generating apparatus **200** passes through an subject **204** and is detected by a detector **206**. The detector **206** converts detected radiation into an image signal and outputs the image signal to a signal processor **205**. The signal processor **205** performs predetermined signal processing of the image signal under the control of the system controlling apparatus **202**, and outputs the processed image signal to the system controlling apparatus **202**. Based on the processed image signal, the system controlling apparatus **202** outputs, to a display apparatus **203**, a display signal for causing the display apparatus **203** to display an image. The display apparatus **203** displays, on a screen, an image based on the display signal as an image of the subject **204**. A representative example of the radiation is X-rays. The radiation generating apparatus and the radiation imaging system according to the present invention can be used as an X-ray generating apparatus and an X-ray image taking system, respectively. The X-ray image taking system can be used for non-destructive testing of an industrial product or pathological diagnosis of a human or an animal.

Example

A radiation imaging system using the radiation generating apparatus **200** as illustrated in FIG. **1** was manufactured.

The manufactured envelope **1** of the movable diaphragm unit **102** was sized to be 50×50×30 mm. A resin sheet containing tungsten powder was attached to inner surfaces of the envelope **1** for preventing leakage of diffused radiation. The light source **2** which was an LED, the light guiding plate **3**, and the louver **4** were provided in the envelope **1**. The louver **4** was provided adjacent to the front surface of the light guiding plate **3** so that directionality was able to be given by the louver **4** to visible light from the light source **2** which exited from the front surface of the light guiding plate **3**. As the light guiding plate **3**, an acrylic resin plate was used. In the acrylic resin plate, the rear surface had ground glass-like irregularities formed thereon, the rear surface and three side surfaces except a side surface opposed to the light source **2** had a reflecting material provided thereon, and surface emission was possible from the front surface by light emission from the light source **2**. The louver **4** had the shape of the intersecting slits illustrated in FIG. **3**A, and was an aggregation of the partition walls **10** formed of a plate-like (tape-like) graphite foil having a thickness of about 75 μm and a width of 2.5 mm. The partition walls were provided in two stages in which the parallel partition walls **10** at intervals of about 50 μm were arranged in directions perpendicularly intersecting each other, respectively, under a state in which the angle of the partition walls **10** was changed so that extensions of exiting visible light to the radiation generating unit **101** side converged to the radiation focus **8**. Further, the limiting leaves **5** were provided in the envelope **1** so that the size of the radiation field **6** was able to be adjusted.

The above-mentioned movable diaphragm unit **102** was mounted to the radiation generating unit **101** to manufacture the radiation generating apparatus **200** illustrated in FIG. **1**. Operation of a radiation imaging system using the radiation generating apparatus **200** was confirmed. As a result, it was confirmed that it was possible to form the visible light field **11** substantially coincident with the radiation field **6**. When radiation was emitted, it was possible to obtain a satisfactory image without a shadow of the louver **4** and without the heel effect. Further, the weight of the entire movable diaphragm unit **102** was measured to be about 200 g, which meant that it was possible to attain significant weight reduction compared with a conventional unit.

Comparative Example

A conventional ordinary movable diaphragm unit was manufactured using a light source, which was a tube lamp having a diameter of about 20 mm, and a reflecting plate provided so as to be slanted with respect to the radiation axis. The envelope was sized to be 200×200×150 mm, and weighed about 2 kg.

The radiation generating apparatus according to the present invention can form the visible light field without using a reflecting plate, by emitting visible light emitted from the light source through the light guiding plate and the louver. The light guiding plate is provided perpendicularly to the radiation axis. Thus, large space necessary for installing, for example, a reflecting plate provided so as to be slanted with respect to the radiation axis is not necessary, and the envelope which houses the light guiding plate can be downsized accordingly. Therefore, the size and the weight of the envelope can be reduced, and, by extension, the sizes and the weights of the radiation generating apparatus and the radiation imaging system can be reduced. Further, the amount of radiation absorbed by the light guiding plate is smaller than that absorbed by a metal which is ordinarily used for a reflecting plate, and thus, radiation quality distribution generated when a radiation tube of a transmission type is used can be inhibited. The radiation imaging system using the radiation generating apparatus according to the present invention can take a satisfactory image using radiation of uniform radiation quality.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2012-162245, filed Jul. 23, 2012, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An X-ray generating apparatus, comprising:

an X-ray generating unit having a target and an electron source emitting an electron beam toward said target so as to form a focal spot on said target; and

a light projecting and sighting unit that comprises:

a movable diaphragm unit having a plurality of limiting leaves;

a light source emitting visible light;

a light guiding plate provided across an X-ray axis so as to cover the path of the X-ray that irradiates an X-ray field, the light guiding plate being configured to transmit the X-ray and cause the visible light from said light source to exit from a front surface of said light guiding plate; and

an X-ray transmissive louver having a plurality of partition walls defining an opening between two adjacent partition walls of the plurality of partition walls so as to transmit the X-ray and give directionality to the visible light emitted from said front surface,

wherein said X-ray transmissive louver is secured at said front surface of said light guiding plate and is located between said light guiding plate and said limiting leaves so as to indicate a simulated X-ray irradiation field with visible light on a subject.

2. The X-ray generating apparatus according to claim **1**, wherein said X-ray transmissive louver comprises any one of a graphite foil, paper that blocks light, and a synthetic resin film that blocks light.

3. The X-ray generating apparatus according to claim **1**, wherein said X-ray transmissive louver comprises light exiting cells formed of intersecting slits that are formed by arranging, in two stages, multiple plate-like partition walls in directions intersecting each other, respectively.

4. The X-ray generating apparatus according to claim **3**, wherein said light exiting cells each have an aspect ratio that is a ratio h/w between a width w and a height h of 50 or more and 500 or less.

5. The X-ray generating apparatus according to claim **3**, wherein said multiple plate-like partition walls are slanted on an outer peripheral side in a state in which an amount of the slant is gradually increased from the X-ray axis side to the outer peripheral side.

6. The X-ray generating apparatus according to claim **5**, wherein slanted surfaces of said multiple plate-like partition walls comprise slanted surfaces that, when said slanted surfaces are extended to the X-ray generating unit side, converge to an X-ray focus.

7. The X-ray generating apparatus according to claim **1**, wherein said X-ray transmissive louver comprises light exiting cells formed into a grid by crossing and combining multiple plate-like partition walls in one plane.

8. The X-ray generating apparatus according to claim **1**, wherein said X-ray transmissive louver comprises light exiting cells formed into a shape of a honeycomb that is an aggregation of multiple hexagonal partition walls.

9. The X-ray generating apparatus according to claim **1**, wherein said light guiding plate and said X-ray transmissive louver are configured to be retracted outside the path of the X-ray that irradiates the X ray field.

10. The X-ray generating apparatus according to claim **1**, wherein said X-ray generating unit comprises a transmitting type X-ray tube.

11. The X-ray generating apparatus according to claim **10**, wherein said transmitting type X-ray tube has a transmitting type target having a target layer and a transmitting member supporting said target layer, and wherein the front surface of said light guiding plate is parallel to said target layer.

12. The X-ray generating apparatus according to claim **1**, wherein said light guiding plate is disposed in a direction orthogonal to the X-ray axis.

13. An X-ray imaging system, comprising:

the X-ray generating apparatus according to claim **1**;

an X-ray detecting apparatus for detecting the X-ray that is emitted from said X-ray generating apparatus and passes through a subject; and a controlling apparatus for controlling said X-ray generating apparatus and the said X-ray detecting apparatus in a coordinated manner.

14. The X-ray generating apparatus according to claim **1**, wherein said light source is located outside an imaginary conic X-ray beam passing through an opening defined with said limiting leaves.

15. The X-ray generating apparatus according to claim **1**, wherein the front surface of said light guiding plate is located in opposition to an opposite surface facing said focal spot.

16. The X-ray generating apparatus according to claim **1**, wherein said X-ray transmissive louver has a varied pitch of the plurality of partition walls along an X-ray irradiation axis, and wherein a pitch at a limiting leaves side is wider than that at a light guiding plate side.

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